



**[4910-13]**

**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Part 25**

**[Docket No. FAA-2013-0801; Notice No. 25-13-41-SC]**

**Special Conditions:** Airbus Model A350-900 Airplanes; Permanently Installed Rechargeable Lithium-Ion Batteries and Battery Systems

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Notice of proposed special conditions.

**SUMMARY:** This action proposes special conditions for Airbus Model A350-900 series airplanes. These airplanes will have a novel or unusual design feature associated with permanently installed rechargeable lithium-ion batteries and battery systems. These batteries have certain failure, operational, and maintenance characteristics that differ significantly from those of the nickel-cadmium and lead-acid rechargeable batteries currently approved for installation on large transport-category airplanes. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These proposed special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** Send your comments on or before **[insert date 30 days after *Federal Register* publication]**.

**ADDRESSES:** Send comments, identified by docket number FAA-2013-0801, using any of the following methods:

- Federal eRegulations Portal: Go to <http://www.regulations.gov/> and follow the online instructions for sending your comments electronically.
- Mail: Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE., Room W12-140, West Building Ground Floor, Washington, D.C., 20590-0001.
- Hand Delivery or Courier: Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, D.C., between 8 a.m. and 5 p.m., Monday through Friday, except federal holidays.
- Fax: Fax comments to Docket Operations at 202-493-2251.

Privacy: The FAA will post all comments it receives, without change, to <http://www.regulations.gov/>, including any personal information the commenter provides. Using the search function of the docket web site, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). DOT's complete Privacy Act Statement can be found in the *Federal Register* published on April 11, 2000 (65 FR 19477-19478), as well as at <http://DocketsInfo.dot.gov/>.

Docket: Background documents or comments received may be read at <http://www.regulations.gov/> at any time. Follow the online instructions for accessing the docket or go to the Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, D.C., between 9 a.m. and 5 p.m., Monday through Friday, except federal holidays.

**FOR FURTHER INFORMATION CONTACT:** Nazih Khaouly, FAA, Airplane and Flight Crew Interface Branch, ANM-111, Transport Airplane Directorate, Aircraft Certification

Service, 1601 Lind Avenue SW., Renton, Washington, 98057-3356; telephone 425-227-2432; facsimile 425-227-1149.

## **SUPPLEMENTARY INFORMATION:**

### **Comments Invited**

We invite interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the special conditions, explain the reason for any recommended change, and include supporting data.

We will consider all comments we receive on or before the closing date for comments. We may change these special conditions based on the comments we receive.

### **Background**

On August 25, 2008, Airbus applied for a type certificate for their new Model A350-900 series airplane. Later, Airbus requested, and the FAA approved, an extension to the application for FAA type certification to June 28, 2009. The Model A350-900 series has a conventional layout with twin wing-mounted Rolls-Royce Trent XWB engines. It features a twin aisle, 9-abreast, economy-class layout, and accommodates side-by-side placement of LD-3 containers in the cargo compartment. The basic Model A350-900 series configuration accommodates 315 passengers in a standard two-class arrangement. The design cruise speed is Mach 0.85 with a maximum take-off weight of 602,000 lbs. Airbus proposes the Model A350-900 series to be certified for extended operations (ETOPS) beyond 180 minutes at entry into service for up to a 420-minute maximum diversion time.

Existing airworthiness regulations did not anticipate the use of lithium-ion batteries and battery systems on aircraft. Lithium-ion batteries and battery systems have new hazards that were not contemplated when the existing regulations were issued. In Title 14, Code of Federal

Regulations (14 CFR) 25.1353, the FAA provided an airworthiness standard for lead-acid batteries and nickel-cadmium batteries. These special conditions provide an equivalent level of safety as that of the existing regulation. The current regulations are not adequate for rechargeable lithium-battery and battery system installations. Additional lithium-battery and battery system special conditions are required to ensure the same level of safety as set forth by the existing regulation intended for other battery technology.

### **Type Certification Basis**

Under the provisions of 14 CFR 21.17, Airbus must show that the Model A350-900 series meets the applicable provisions of 14 CFR part 25, as amended by Amendments 25-1 through 25-128.

The FAA has determined that Airbus Model A350-900 series airplanes must comply with the following sections: § 25.863(a) through (d), Amendment 25-61 and Amendment 25-66.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Model A350-900 series because of a novel or unusual design feature, special conditions are prescribed under § 21.16.

Special conditions are initially applicable to the model or series for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same or similar novel or unusual design feature, the special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the Airbus Model A350-900 airplane must comply with the fuel-vent and exhaust-emission requirements of 14 CFR part 34, the noise-certification requirements of 14 CFR part 36, and the FAA must issue

a finding of regulatory adequacy under § 611 of Public Law 92-574, the “Noise Control Act of 1972.”

The FAA issues special conditions, as defined in § 11.19, under § 11.38, and they become part of the type-certification basis under § 21.17(a)(2).

### **Novel or Unusual Design Features**

The Airbus Model A350-900 airplane will incorporate the following novel or unusual design features: permanently installed rechargeable lithium batteries and lithium battery systems.

### **Discussion**

The current regulations governing installation of batteries in large transport-category airplanes were derived from Civil Air Regulations (CAR) part 4b.625(d) as part of the re-codification of CAR 4b that established 14 CFR part 25 in February 1965. The new battery requirements, § 25.1353(c)(1) through (c)(4), basically reworded the CAR requirements.

Increased use of nickel-cadmium batteries in small airplanes resulted in increased incidents of battery fires and failures which led to additional rulemaking affecting large transport-category airplanes as well as small airplanes. On September 1, 1977 and March 1, 1978, the FAA issued § 25.1353(c)(5) and (c)(6), respectively, governing nickel-cadmium battery installations on large transport-category airplanes.

The proposed use of lithium-ion batteries and battery systems for equipment and systems on Airbus Model A350 airplanes has prompted the FAA to review the adequacy of these existing regulations. Our review indicates that the existing regulations do not adequately address several failure, operational, and maintenance characteristics of lithium-ion batteries and battery systems

that could affect the safety and reliability of the Airbus model A350-900 airplane rechargeable lithium batteries and rechargeable lithium-battery-system installations.

At present, commercial aviation has limited experience with use of rechargeable lithium-ion batteries and battery systems in applications involving commercial aviation. However, other users of this technology, ranging from wireless telephone manufacturers to the electric-vehicle industry, have noted potential hazards with lithium-ion batteries and battery systems. These problems include overcharging, over-discharging, and flammability of cell components.

### **1. Overcharging**

In general, lithium-ion batteries and battery systems are significantly more susceptible to internal failures that can result in self-sustaining increases in temperature and pressure (i.e., thermal runaway) than their nickel-cadmium or lead-acid counterparts. This condition is especially true for overcharging, which causes heating and destabilization of the components of the cell, leading to the formation (by plating) of highly unstable metallic lithium. The metallic lithium can ignite, resulting in a self-sustaining fire or explosion. Finally, the severity of thermal runaway, due to overcharging, increases with increasing battery capacity due to the higher amount of electrolyte in large batteries.

### **2. Over-Discharging**

Discharge of some types of lithium-ion batteries and battery systems, beyond a certain voltage (typically 2.4 volts), can cause corrosion of the electrodes of the cell, resulting in loss of battery capacity that cannot be reversed by recharging. This loss of capacity may not be detected by the simple voltage measurements commonly available to flightcrews as a means of checking battery status—a problem shared with nickel-cadmium batteries.

### **3. Flammability of Cell Components**

Unlike nickel-cadmium and lead-acid batteries, some types of lithium-ion batteries and battery systems use liquid electrolytes that are flammable. The electrolyte can serve as a source of fuel for an external fire if there is a breach of the battery container.

The problems lithium-ion battery and battery-system users experience raise concern about the use of these batteries in commercial aviation. The intent of the proposed special conditions is to establish appropriate airworthiness standards for lithium-ion battery installations in Airbus Model A350-900 airplanes and to ensure, as required by §§ 25.1309 and 25.601, that these lithium-ion batteries and battery systems will not result in an unsafe condition. To address these concerns, these special conditions adopt the following requirements:

- Those sections of 14 CFR 25.1353 that are applicable to lithium ion batteries.
- The flammable fluid fire protection requirements of 14 CFR 25.863. In the past, this rule was not applied to batteries of transport category airplanes, since the electrolytes used in lead-acid and nickel-cadmium batteries are not flammable.
- New requirements to address the hazards of overcharging and over-discharging that are unique to lithium ion batteries.
- New maintenance requirements to ensure that batteries used as spares are maintained in an appropriate state of charge.

These special conditions are similar to lithium-ion batteries and battery systems special conditions adopted for the Boeing Model 787 (72 FR 57842; October 11, 2007).

## **Applicability**

As discussed above, these special conditions are applicable to the Airbus Model A350-900 series airplanes. Should Airbus apply later for a change to the type certificate to include another model incorporating the same novel or unusual design feature, the special conditions would apply to that model as well.

## **Conclusion**

This action affects only certain novel or unusual design features on Airbus Model A350-900 series airplanes. It is not a rule of general applicability.

## **List of Subjects in 14 CFR Part 25**

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

## **The Proposed Special Conditions**

Accordingly, the Federal Aviation Administration (FAA) proposes the following special conditions as part of the type certification basis for Airbus Model A350-900 airplanes.

These proposed special conditions require that (1) all characteristics of the rechargeable lithium-ion batteries and battery systems, and their installation, that could affect safe operation of Airbus Model A350-900 airplanes, are addressed, and (2) appropriate Instructions for Continued Airworthiness, which include maintenance requirements, are established to ensure the availability of electrical power, when needed, from the batteries.



The FAA proposes that the following special conditions apply to all rechargeable lithium-ion batteries and battery systems on Airbus Model A350-900 airplanes, in lieu of the requirements of § 25.1353(b)(1) through (b)(4) at Amendment 25-113:

Rechargeable lithium-ion batteries and battery systems on Airbus Model A350-900 airplanes must be designed and installed as follows:

1. Safe cell temperatures and pressures must be maintained during any foreseeable charging or discharging condition, and during any failure of the charging or battery monitoring system not shown to be extremely remote. The rechargeable lithium-ion batteries and battery systems must preclude explosion in the event of those failures.
2. Design of the rechargeable lithium-ion batteries and battery systems must preclude the occurrence of self-sustaining, uncontrolled increases in temperature or pressure.
3. No explosive or toxic gases emitted by any rechargeable lithium-ion batteries and battery systems in normal operation, or as the result of any failure of the battery charging system, monitoring system, or battery installation that is not shown to be extremely remote, may accumulate in hazardous quantities within the airplane.
4. Installations of rechargeable lithium-ion batteries and battery systems must meet the requirements of § 25.863(a) through (d).
5. No corrosive fluids or gases that may escape from any lithium-ion batteries and battery systems may damage surrounding structure or any adjacent systems, equipment, or electrical wiring of the airplane in such a way as to cause a major

or more severe failure condition, in accordance with § 25.1309 (b) and applicable regulatory guidance.

6. Each lithium-ion battery and battery system must have provisions to prevent any hazardous effect on structure or essential systems caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.
7. Rechargeable lithium-ion batteries and battery systems must have a system to automatically control the charging rate of the battery, so as to prevent battery overheating or overcharging, and:
  - i. A battery-temperature sensing and over-temperature warning system with a means for automatically disconnecting the battery from its charging source in the event of an over-temperature condition, or,
  - ii. A battery-failure sensing and warning system with a means for automatically disconnecting the battery from its charging source in the event of battery failure.
8. Any rechargeable lithium-ion batteries and battery systems, the function of which are required for safe operation of the airplane, must incorporate a monitoring and warning feature that will provide an indication to the appropriate flight crewmembers whenever the state-of-charge of the batteries has fallen below levels considered acceptable for dispatch of the airplane.
9. The Instructions for Continued Airworthiness required by § 25.1529 must contain maintenance requirements to assure that the lithium-ion batteries are sufficiently

charged at appropriate intervals specified by the battery manufacturer and the equipment manufacturer of the rechargeable lithium-ion battery or rechargeable lithium-ion battery system. This is required to ensure that rechargeable lithium-ion batteries and battery systems will not degrade below specified ampere-hour levels sufficient to power the aircraft system, for intended applications. The Instructions for Continued Airworthiness must also contain procedures for the maintenance of batteries in spares storage to prevent the replacement of batteries with batteries that have experienced degraded charge-retention ability or other damage due to prolonged storage at a low state of charge. Replacement batteries must be of the same manufacturer and part number as approved by the FAA. Precautions should be included in the Instructions for Continued Airworthiness maintenance instructions to prevent mishandling of the rechargeable lithium-ion batteries and battery systems, which could result in short-circuit or other unintentional impact damage caused by dropping or other destructive means.

Note 1: The term “sufficiently charged” means that the battery will retain enough of a charge, expressed in ampere-hours, to ensure that the battery cells will not be damaged. A battery cell may be damaged by lowering the charge below a point where the battery experiences a reduction in the ability to charge and retain a full charge. This reduction would be greater than the reduction that may result from normal operational degradation.

Note 2: These special conditions are not intended to replace § 25.1353(b) at Amendment 25-113 in the certification basis for Airbus Model A350-900 airplanes. These special conditions apply only to rechargeable lithium-ion batteries and battery systems and their installations. The requirements of § 25.1353(b) at Amendment 25-113 remain in effect for batteries and battery installations on Airbus Model A350-900 airplanes that do not use rechargeable lithium-ion batteries.

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